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Memorandum

To: Michelle Shaughnessy, Assistant Regional Director-Ecological Services, Region 2

From: Adam Zerrenner, Field Supervisor, Austin Ecological Services Field Office, Region 2

Subject: Intra-Service Consultation for the Final 4(d) Rule for the Georgetown Salamander (02ETAU00-2015-F-0321)

This document transmits the U.S. Fish and Wildlife Service (Service) biological and conference opinion based on our review of the proposed 4(d) rule and its effects on the Georgetown salamander in accordance with section 7 of the Endangered Species Act of 1973 (Act), as amended. Because critical habitat for the Georgetown salamander is still proposed, this opinion represents a formal conference incorporated into a formal consultation package.

This biological and conference opinion is based on information provided in the April 9, 2015, proposed rule (80 FR 19050), March 12, 2015 draft environmental assessment, the February 24, 2015 City of Georgetown Unified Development Code, conversations with City of Georgetown staff, and other sources of information. A complete administrative record of this consultation is on file at the Austin Ecological Services Field Office.

Consultation History

The Georgetown salamander was included in 10 Candidate Notices of Review between 2001 and 2011. In the 2008 review, the listing priority number was lowered from 2 to 8, indicating that threats to the species were imminent, but moderate to low in magnitude. This reduction in listing priority number was primarily due to the land acquisition and conservation efforts of the Williamson County Conservation Foundation. In addition, we were petitioned by the Center for Biological Diversity to list the Georgetown salamander as an endangered species on May 11, 2004, but at that time, it was already a candidate species whose listing was precluded by higher priority actions.

On August 22, 2012, we published a proposed rule to list as endangered and designate critical habitat for the Austin blind salamander (*Eurycea waterlooensis*), Jollyville Plateau salamander (*Eurycea tonkawae*), Georgetown salamander, and Salado salamanders (*Eurycea chisholmensis*)

(77 FR 50768). That proposal had a 60-day comment period, ending October 22, 2012. On January 25, 2013, we reopened the public comment period on the August 22, 2012, proposed listing and critical habitat designation; announced the availability of a draft economic analysis; and an amended required determinations section of the proposal (78 FR 5385). On August 20, 2013, we extended the final determination for the Georgetown and Salado salamanders by 6 months due to substantial disagreement regarding: (1) The short and long-term population trends of these two species; (2) the interpretation of water quality and quantity degradation information as it relates to the status of these two species; and (3) the effectiveness of conservation practices and regulatory mechanisms (78 FR 51129). That comment period closed on September 19, 2013.

Since that time, the City of Georgetown, Texas, prepared and finalized ordinances for the Georgetown salamander. All 18 of the known Georgetown salamander locations are within the City of Georgetown's jurisdiction for residential and commercial development. The enacted ordinances were directed at alleviating threats to the Georgetown salamander from urban development by requiring geologic assessments prior to construction, establishing occupied site protections through stream buffers, maintaining water quality through best management practices, developing a water quality management plan for the City of Georgetown, and monitoring occupied spring sites by an adaptive management working group. In order to consider the ordinances in our final listing determination, on January 7, 2014 (79 FR 800), we reopened the comment period for 15 days on the proposed listing rule to allow the public an opportunity to provide comment on the application of the City of Georgetown's ordinances to our status determination under section 4(a)(1) of the Act. We published the final rule to list the Georgetown and Salado salamanders as threatened on February 24, 2014 (79 FR 10236).

Biological and Conference Opinion

I. Action Area and Description of the Proposed Action

Action Area

For the purposes of section 7 consultation, the Service defines the action area as all areas to be affected directly or indirectly by the Federal action and not merely the immediate area affected by the project (50 CFR 402.02). We have determined that the action area for this biological and conference opinion includes the entire jurisdiction of the City of Georgetown including the city limits and the extra-territorial jurisdiction (Figure 1), which falls under the City of Georgetown Unified Development Code (UDC).

The City of Georgetown is located in Williamson County, Texas, and its jurisdiction covers approximately 115,233 acres. Approximately 83 percent (95,434 acres) of the jurisdiction overlays the recharge and contributing zones of the Northern Segment of the Edwards Aquifer. Five major streams run through the city: Dry Berry Creek, Berry Creek, and the North, Middle, and South Forks of the San Gabriel River. The entire known range of the Georgetown salamander lies within the City of Georgetown (Figure 1). Approximately 10 percent (42,853

acres) of the total land draining into each Georgetown salamander surface site (stream and spring sites) falls under the City of Georgetown jurisdiction.

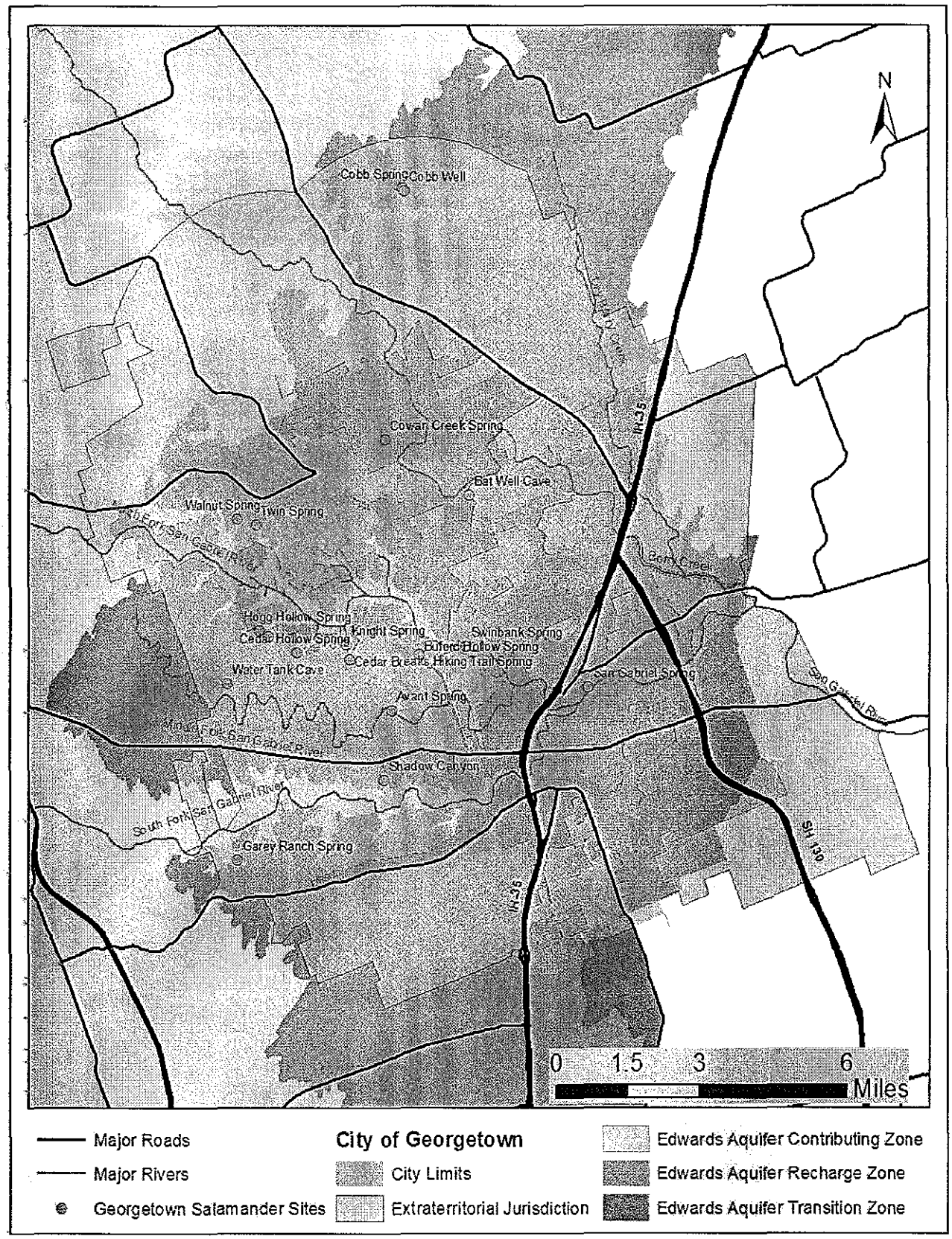

Figure 1: Action Area

Description of Proposed Action

On February 24, 2014, the Service published a proposed rule under authority of section 4(d) of the Act for the Georgetown salamander (79 FR 10077). This proposed rule was amended on April 9, 2015 (80 FR 19050). Currently, the rule proposes that take of Georgetown salamanders that is incidental to regulated activities that are conducted consistent with the water quality regulations contained in chapter 11.07 and Appendix A of the City of Georgetown Unified Development Code (UDC 11.07) (*https://udc.georgetown.org/*) would not be prohibited under the Act. These water quality regulations in the UDC were finalized on February 24, 2015. This opinion analyzes the effects of chapter 11.07 and Appendix A of the UDC on the Georgetown salamander.

Chapter 11.07 of the UDC describes stream and spring buffers, water quality best management practices, and geologic assessments that are required for property development within the Northern Edwards Aquifer Recharge Zone and the City of Georgetown. When a property owner submits a development application for a regulated activity on a tract of land located over the Edwards Aquifer Recharge Zone, that individual is required to submit a geologic assessment. The geologic assessment identifies and describes all springs and streams on any subject property, and the UDC establishes buffer zones around identified springs and streams. For springs, the buffer encompasses 50 meters (164 feet) extending from the approximate center of the spring outlet that is identified in a geologic assessment. For streams, the boundaries of the buffer must coincide with either the boundaries of the Federal Emergency Management Agency 1 percent floodplain or a calculated 1 percent floodplain, whichever is smaller. Thus, these stream buffers may vary depending on the size of the stream, but they may be no smaller than 61 meters (200 feet) wide with at least 23 meters (75 feet) from the centerline of the stream. Section 11.07.003 of the UDC states that no "regulated activities" may be conducted within the spring and stream buffers. "Regulated activities" are defined in Title 30, Texas Administrative Code section 213.3(28) as any construction-related or post-construction activities on the Recharge Zone of the Edwards Aquifer having the potential for polluting the Edwards Aquifer and hydrologically connected surface streams. In addition to the establishment of these spring and stream buffers, the UDC outlines water quality best management practices designed to minimize sediment runoff, increase the removal of total suspended solids, prevent an increase in flow rates, and ensure spill containment for new or expanded roadways. These regulations in chapter 11.07 of the UDC are designed to reduce water quality degradation that may occur as a result of development. Properties with a site occupied by the Georgetown salamander are exempt from the spring and stream buffer requirements in chapter 11.07. Rather, UDC Appendix A outlines voluntary conservation measures to be implemented when undertaking regulated activities that occur on a tract of land with an occupied site, or within 300 meters (984 feet) of an occupied site.

For activities involving habitat occupied by the Georgetown salamander, the Service proposed that take of the Georgetown salamander that is incidental to regulated activities that are conducted consistent with the voluntary guidelines described in Appendix A of the UDC will not be prohibited under the Act. Similar to chapter 11.07 of the UDC, the guidelines in Appendix A establish stream and spring buffers and allowable activities within those buffers; however, the measures described in Appendix A create larger, more protective buffers than those that appear

in chapter 11 for unoccupied sites. First, Appendix A establishes a "No-Disturbance Zone" in the stream or waterway that a spring drains directly into; this zone extends 80 meters (264 feet) upstream and downstream from the approximate center of the spring outlet of an occupied site and is bounded by the top of the bank. No regulated activities may occur within the "No-Disturbance Zone." In addition, Appendix A establishes a "Minimal-Disturbance Zone" for the subsurface area that drains to the spring(s) at an occupied site; this zone consists of the area within 300 meters (984 feet) of the approximate center of the spring outlet of an occupied site, except those areas within the "No-Disturbance Zone." Most regulated activities are also prohibited in the "Minimal-Disturbance Zone," but single-family developments; limited parks and open space development; and wastewater infrastructure will be allowed.

Section 11.07.008 of the UDC also establishes an Adaptive Management Working Group (Working Group) that is responsible for reviewing monitoring data (for example, water quality, salamander population, or substrate data) on a regular basis and making recommendations for specific changes in the management directions related to the voluntary conservation measures for occupied sites in Appendix A. Adaptive management of conservation of the Georgetown salamander is one of the duties tasked to the Working Group. Therefore, the guidelines described in Appendix A may change over time. Appendix A also indicates that the Working Group is authorized to hear and make recommendations to the Service regarding variances from the voluntary guidelines on a case-by-case basis as long as the proposed variance will achieve the same level or greater level of water quality benefits and conservation objectives to the Georgetown salamander. The Working Group will also develop an annual report regarding the preservation of the Georgetown salamander, continuous monitoring of the Georgetown salamander, assessment of research priorities, and the effectiveness of the water quality regulations and guidelines.

The following federally listed endangered species also occur in action area: Coffin Cave mold beetle *(Batrisodes texanus)*, Bone Cave harvestman *(Texella reyesi)*, golden-cheeked warbler (*Dendroica chrysoparia*), and the black-capped vireo (*Vireo atricapilla*). These species are covered species under the Williamson County Regional Habitat Conservation Plan. The Service issued a section 10(a)(1)(B) permit to Williamson County in 2008 (TE-181840-0) authorizing incidental take of these species which occur in the action area, and requiring the county to implement certain conservation actions for each of these species. The County's plan does not cover incidental take of any salamander species. Non-federal projects may enroll in the County's plan to obtain incidental take coverage for the covered species or apply for an incidental take permit from the Service. Therefore, the proposed action will have no effect on the Coffin Cave mold beetle, Bone Cave harvestman, golden-cheeked warbler, and black-capped vireo.

II. Status of Georgetown Salamander

On February 24, 2014, the Service published its final rule to list the Georgetown salamander as a threatened species, and we concurrently published a proposed 4(d) special rule containing measures that provide for the conservation of the species (79 FR 10077). This proposed rule was amended on April 9, 2015 (80 FR 19050). Currently, both the special rule and critical habitat are proposed.

A. Description of Species and Proposed Critical Habitat

The Georgetown salamander is an aquatic and neotenic (retains juvenile characteristics at maturity) amphibian. Adults are about two inches long and have a broad, relatively short head with three pairs of bright-red gills on each side behind the jaws, a rounded and short snout, and large eyes with a gold iris. The upper body is generally grayish with varying patterns, while its underside is pale and translucent. The tail tends to be long with poorly developed dorsal and ventral fins that are golden-yellow at the base and cream-colored to translucent toward the outer margin. Unlike the Jollyville Plateau salamander, the Georgetown salamander has a distinct dark border along the lateral margins of the tail fin (Chippindale *et al.* 2000).

Proposed critical habitat consists of four components: (1) water from the Northern Segment of the Edwards Aquifer, (2) rocky substrate with interstitial spaces, (3) aquatic invertebrates for food, and (4) subterranean aquifer for shelter and protection during periods of drought or dewatering on the surface in and around spring sites. Proposed critical habitat includes both surface and subsurface habitats. The proposed surface critical habitat would include the spring outlets and the spring run extending 50 meters (164 feet) downstream. Generally, the proposed subsurface critical habitat would include the groundwater and water-filled conduits of the Edwards Aquifer within 300 meters (984 feet) of the spring (or water-filled) cave.

B. Life History

Georgetown salamanders live underwater in springs, creeks, pools, and in the water-filled spaces in subterranean karst rock. Typically, Georgetown salamanders are found where the gravel and cobble substrate is suitable to meet their life history requirements and prefer to use larger cobble and boulders as cover from predators (Pierce *et al.* 2010). Georgetown salamanders are usually within 50 meters (164 feet) of a spring outlet (Pierce *et al.* 2011a) but are more abundant within 4.9 meters (16 feet) of a spring (Pierce *et al.* 2010). In contrast, Jollyville Plateau salamanders, a closely related species, have been found farther from spring openings. During a recent mark-recapture study of Jollyville Plateau salamanders in a nearby watershed, researchers found marked individuals moved up to 79.9 meters (262 feet) both upstream and downstream from a spring outlet (Bendik 2013, pers. comm.) suggesting that *Eurycea* salamanders in central Texas can travel greater distances from a spring opening than was previously thought.

Feeding biology in Georgetown salamanders has not been studied, but if similar to other central Texas *Eurycea*, Georgetown salamanders feed on amphipods, ostracods, chironomid larvae and pupae, and small snails (Tupa and Davis 1976).

Reproductive biology in the Georgetown salamander has not been studied. Assuming reproduction in Georgetown salamanders is similar to the San Marcos salamander (*Eurycea nana*), males would become sexually mature the time that they grow to a snout-vent length of about 20 millimeters (0.79 inch). Female San Marcos salamanders with a snout-vent length greater than 20 millimeters (0.79 inch) carry ova (Tupa and Davis 1976) and are considered gravid. *Eurycea* may become sexually mature in less than one year (Gluesenkamp, TPWD, pers.

comm. 2014). Courtship and egg deposition by the Georgetown salamander have not been observed. Pierce (2012) and Pierce and McEntire (2013) reported the percent gravid Georgetown salamanders found in monthly surveys at Twin Springs and Swinbank Springs. It appears gravid Georgetown salamanders peak in late fall and spring with few or no gravid Georgetown salamanders reported in most summer months. The majority of gravid salamanders observed were found from November through April.

Predator recognition and avoidance by San Marcos salamanders was documented by Epp and Gabor (2008). The most likely predators of Georgetown salamanders include sunfish, snakes, and birds, particularly waterbirds.

C. Population Dynamics

It is not known or estimated how many Georgetown salamanders there are range-wide. We know of only two locations where the Georgetown salamander population has been estimated. These estimates were made from data collected at Twin Springs and Swinbank Springs, both located in Williamson County, Texas. The information collected from these sites indicates that the populations change seasonally, increasing in the spring and decreasing in the fall with wide monthly variations (Pierce and McEntire 2013).

The number of Georgetown salamanders at a location can be estimated using different methods. Recent mark-recapture studies estimate a population size of 100 to 200 adult salamanders each at Twin Springs and Swinbank Spring (Pierce 2011a, Pierce *et al.* 2014). At other sites the number of Georgetown salamanders is unknown. In some instances, researchers have counted salamanders seen at the surface. This method is expected to undercount salamanders because it relies on only those that can be seen at the surface. In our review of survey data, we found that with the exception of Twin Springs and Swinbank Springs, all sites that had been surveyed in the last 10 years had less than 50 Georgetown salamanders. In some cases, there were considerably fewer salamanders (as little as four) and at some sites, Georgetown salamanders could no longer be found.

There are other springs in Williamson County that may support Georgetown salamander populations, but access to the private lands where these springs are found has not been allowed, which has prevented surveys being done at these sites (Williamson County 2008).

D. Status and Distribution

The entire range of the Georgetown salamander is in within Williamson County, Texas. All of the known occupied Georgetown salamander locations are either at spring outlets or in wet caves. The known surface spring locations are in the San Gabriel river basin, specifically in five of its tributaries (South Fork, Middle Fork, North Fork, Berry Creek, and Cowan Creek). A groundwater divide between the watershed of the South Fork of the San Gabriel River and Brushy Creek watershed to the south likely creates the division between the ranges of the Jollyville Plateau salamanders and Georgetown salamanders (Williamson County 2008). Table 1 and Figure 1 show the current and historical Georgetown salamander localities.

Table 1. Historic Georgetown Salamander Localities

Site No.	Site Name	Population Size
1	Avant Spring	Unknown
2	Bat Well Cave	Unknown
3	Buford Hollow Spring	Unknown, May Be Extirpated
4	Cedar Breaks Hiking Trail Spring	Unknown
5	Cedar Hollow Spring	Unknown
6	Cobb Spring	Unknown
7	Cobb Well	Unknown
8	Cowan Creek Spring	Unknown
9	Garey Ranch Spring	Unknown
10	Hog Hollow Spring	Unknown
11	Hog Hollow II Spring	Unknown
12	Knight Spring	Unknown
13	San Gabriel Spring	Unknown, May Be Extirpated
14	Shadow Canyon	Unknown
15	Swinbank Spring	100 - 200
16	Twin Spring	100 - 200
17	Walnut Spring	Unknown
18	Water Tank Cave	Unknown

Surveys have not been consistently conducted at all sites, confounding the difficulty of estimating population size and trends. For example, the Georgetown salamander has not been observed in more than 10 years at two spring sites (San Gabriel Spring and Buford Hollow Spring) despite several visual survey efforts (Pierce 2011, Southwestern University, pers. comm.). While we are unaware of any population surveys in the last 10 years from a number of sites, the Georgetown salamander continues to be present at the following sites: Avant Spring, Swinbank Spring, Knight Spring, Twin Springs, Cowan Creek Spring, Cedar Hollow Spring, Cobb Spring, Cobb Well, Walnut Spring, and Water Tank Cave (Pierce 2011c, pers. comm.; Gluesenkamp 2011a, TPWD, pers. comm.). For the most recent information on the distribution of this species, please see the final listing rule published in the Federal Register on February 24, 2014. To summarize, of the 18 known or historically occupied Georgetown salamander sites, only 12 sites have been recently surveyed (in the past 10 years) and confirmed to have Georgetown salamanders present. Of these 12 sites, only 2 sites (Swinbank Spring and Twin Spring) have been surveyed consistently (monthly) (Pierce and McEntire 2013).

The distribution of aquatic organisms is often described by the watersheds in which they occur. The United States is divided and sub-divided into successively smaller hydrologic units. The nested units represent watersheds that are uniquely identified using a system of hydrologic unit codes (HUCs). The number of digits in a HUC indicates the level of watershed where fewer digits are larger watersheds and more digits are smaller sub-basins within the larger watersheds. Considering the full range of the Georgetown salamander, all known localities are found in one HUC-8 watershed, four HUC-10 watersheds, and six HUC-12 watersheds.

There are 14 proposed critical habitat units distributed across the known range of the species at sites that have been monitored recently and others that have not been recently surveyed. The most southern subwatershed with a proposed critical habitat unit, the Lower South Fork of the San Gabriel River, has only one proposed critical habitat unit (unit 13). In contrast, the Lake Georgetown subwatershed, has seven proposed critical habitat units.

Reasons for Listing

1. Habitat Modification

Habitat modification is the primary threat to the Georgetown salamander. The Georgetown salamander faces habitat modification from degraded water quality, reduced water quantity, and physical habitat disturbance. Urbanization within the watershed is one of the activities resulting in pollution that may decrease water quality in stormwater, groundwater, and springflow. Urbanization of a watershed may modify the spatial distribution and rates of infiltration in the recharge zone. Urbanization results in an increase in impervious cover and typically an engineered stormwater system to convey runoff, resulting in decreased groundwater recharge.

Impervious Cover and Contaminants in Runoff

The Service has reviewed and analyzed the published effects of impervious cover in its February 24, 2014, final rule (final rule) to list the Georgetown salamander as a threatened species (79 FR 10236). While the effects of an increase in impervious cover for a given site depend on local conditions, the observed trend is a degradation of aquatic habitats that increases with greater levels of impervious cover.

In the final rule, we also describe the contaminants expected to be found in urban runoff and as a result of land applications in the action area. Residential subdivisions in central Texas often include lawn irrigation systems that may overwater the turfgrass and ornamental gardens. Irrigation systems may leak, creating a means of transporting chemicals used in lawn applications to underground or downstream salamander habitat. In addition to suspended solids, nutrients (primarily nitrogen and phosphorous compounds), trace metals (for example, lead, copper, and zinc), pesticides (includes herbicides), and coliform bacteria are transported by runoff. Runoff with these contaminants may result in a decrease in invertebrates including part of the salamander's prey base. Polluted runoff may also directly affect salamander health, growth, reproduction, and potentially survival (Burton and Ingersoll 1994, Turner and O'Donnell 2004). Apparently unregulated in Williamson County, coal tar based pavement sealants may result in high concentrations of polycyclic aromatic hydrocarbons (PAHs) in downstream salamander habitat. PAHs at certain concentrations and exposures are known to adversely affect freshwater invertebrates and amphibians (Albers 2003, Sparling *et al.* 2009).

Vulnerability of Groundwater to Pollution

Alley *et al.* (1999) stated "in principle, virtually any human activity at and near the land surface can be a source of contaminants to ground water as long as water and possibly other fluids move from the land surface to the water table." The first step and challenge to protecting ground water quality and quantity in Williamson County (that Georgetown salamanders rely on) is to know which areas contribute recharge to the subject springs and caves. Unfortunately, in springs and caves with karst aquifers as a source, a significant difficulty is identifying the recharge zone, which may or may not coincide with the surface watershed. The recharge zone for a subject spring, referred to here as the springshed, may conform or overlap with the surface watershed in part or in whole. However, while karst groundwater flows downgradient, the flow paths do not necessarily conform to surface topography and groundwater may flow under topographic highs (B. Mahler, USGS, pers. comm., 2013). Groundwater dye tracing is considered the primary means of delineating the springshed and recharge features. Groundwater dye tracing has not been done in the action area. Therefore, we do not know specifically how water moves through the action area.

The Southern Edwards Aquifer, located near San Antonio, Texas, is a well-studied part of the Edwards Aquifer that is similar in structure to the action area. The United States Geological Survey (USGS) considered multiple methods of assessing the vulnerability of groundwater to contamination in the San Antonio, Texas area (Clark 2000, Clark 2003). These reports analyzed natural aspects related to soils, hydraulic properties of outcropping hydrogeologic units, presence or absence of caves, sinkholes and closed depressions, and slope of land surface. In short, areas of the Edwards aquifer recharge zone with caves are rated relatively high for vulnerability to contamination. Additionally, abandoned wells may become conduits for groundwater pollution. Musgrove *et al.* (2011) identified the following anthropogenic sources that may affect groundwater quality: (1) septic systems, (2) leakage from municipal water and wastewater systems, (3) industrial, commercial, or residential use of fertilizers, pesticides, and volatile organic compounds (VOCs).

The Edwards Aquifer recharge zone in Williamson County is at risk from hazardous material that may be spilled or leaked potentially contaminating surface water, groundwater, or both. Spills may be the result of vehicle, pipeline, or industrial accidents. Quarry operations may also result in groundwater pollution. For example, in January 2000, aboveground storage tanks at a quarry in Comal County spilled more than 2,600 gallons of diesel fuel. Markers diagnostic of diesel (naphthalenes and xylenes) surfaced at Comal Springs (Spring Run 1) about 6.4 kilometers (4 miles) away in 9 days (indicating a groundwater velocity of 0.75 kilometers (0.47 miles) per day).

Since these salamanders and their prey are strictly aquatic, water quality has been considered a main concern. All known Georgetown salamander localities are in Williamson County. Williamson County is experiencing rapid population growth and urbanization. Urbanization degrades water quality in stormwater runoff by increasing pollutant loads of sediment; oil, grease, and toxic chemicals from motor vehicles; pesticides and excess nutrients from lawns and gardens; viruses, bacteria and nutrients from pet waste and sewage systems; heavy metals from

roof materials and motor vehicles; and thermal pollution from impervious surfaces such as streets and rooftops (USEPA 2003).

Water Quantity Reduction in Relation to Urbanization or Industry Effects

Adequate springflows and groundwater levels are essential to maintaining the known populations of Georgetown salamander. Georgetown salamander populations in water-filled caves may also need groundwater movement through their habitat. A risk to Georgetown salamander populations is groundwater development (pumping). Pumping during severe drought may result in loss of springflow and loss of all accessible salamander habitat. Limestone rock quarries are near several Georgetown salamander sites. Quarries may use groundwater. Quarrying physically modifies the surface - subsurface and may alter groundwater levels and flowpaths by lowering the land surface, potentially dewatering hydrologically connected areas.

The reduction or cessation of springflow at springs supporting Georgetown salamanders may result in extirpation of that population. Boghici (2011), referring in part to Williamson County, noted that the northern section of the Edwards Aquifer lacks a contributing zone and recharge is mostly from diffuse infiltration of rainfall on the Edwards Limestone outcrop. Williamson County is in the State of Texas' Groundwater Management Area 8. However, there are no groundwater conservation districts in Williamson County. The future aquifer levels of the Edwards Aquifer in Williamson County will depend on precipitation, the recharge rate, springflow rates, and groundwater demand.

2. Physical Modification of Surface Habitat

Physical modification of surface habitat in the action area may occur through impoundments, feral hogs, and livestock. Cattle and horses may trample spring runs. In addition to habitat modification, other factors are contributing to the decline of the species, such as disease, predation, inadequacy of existing regulatory mechanisms, and other natural or manmade factors. The species is at further risk because of its highly restricted range, small habitat patch sizes, and small population sizes.

Feral hogs, livestock, and human activities are among the most likely ways that spring sites may be disturbed. Feral hogs are becoming more abundant at spring sites with salamanders in Bell, Travis, and Williamson counties (O'Donnell 2006). The February 22, 2013, Austin American Statesman (Claire Osborn) reported on a local forum with Georgetown Police and others on feral hog problems in the Georgetown area. White (2011) reported cattle are present at two of the Georgetown salamander localities. Cattle and other livestock may trample and disturb wetland and riparian areas. It appears there are multiple instances humans have deposited gravel in spring habitat supporting *Eurycea*, potentially resulting in loss or severe reduction in suitable salamander habitat. This may be the case at the spring complex in San Gabriel River Park, where the Georgetown salamander may be extirpated.

3. Small Population Size, Drought, Flooding, and Climate Change

As detailed in the final rule, there are other factors that may affect the continued occupation of a site by the Georgetown salamander and the viability of the taxon. Available evidence, with the exception of a few sites, indicates that most local populations appear to be less than 200 individuals. The census size drives demographic and ecological processes while the effective population size determines the population response to evolutionary forces (Waples 2010). If sex ratios are skewed and/or non-random mating occurs, the effective population size of these sites will be significantly less than 200. These small population sizes make the populations vulnerable to local extinction due to demographic and environmental factors. As Morris and Doak (2002) put it, given a small populations size, "a string of bad years will cause it to actually hit the (extinction) threshold".

Drought, particularly a multiyear drought, may reduce or eliminate habitats range-wide. Severe drought would lower surface water supplies and ground water levels. Lower groundwater levels means some springs will have decreased springflow or will cease to flow altogether. Flooding may result in geomorphic changes to the river channel, potentially scouring springs along the river margin. Lastly, according to Alley *et al.* 1999, climate change could affect groundwater sustainability in several ways: "(1) changes in ground-water recharge resulting from changes in average precipitation and temperature or in the seasonal distribution of precipitation, (2) more severe and longer lasting droughts, (3) changes in evapotranspiration resulting from changes in vegetation, and (4) possible increased demands for ground water as a backup source of water supply". While climate models are being downscaled to address regions like central Texas, there are indications that the southwest part of the U.S. will experience temperature increases along with more frequent hot extremes, heat waves, and heavy precipitation (IPCC 2007).

Summary of Threats to the Georgetown Salamander

The primary threat to the Georgetown salamander is habitat modification in the form of reduced springflows and degraded water quality in spring habitats as result of urbanization of the watersheds and recharge zones in Williamson County. Table 2 assigns known threats to the five factors used for listing decisions. The five factors are: (A) the present or threatened destruction, modification, or curtailment of its habitat or range; (B) overutilization for commercial, recreational, scientific, or educational purposes; (C) disease or predation; (D) the inadequacy of existing regulatory mechanisms; or (E) other natural or manmade factors affecting its continued existence. The rule provides a qualitative value of the expected level of the impact of the threat on the Georgetown salamander, which may change based on new information.

Table 2. Threats to the Georgetown Salamander

Factor	Type of Threat
A	Contaminants from stormwater runoff
A	Sedimentation from stormwater runoff

Factor	Type of Threat
A	Changes in flow regime from impervious cover
A	Excess nutrient input
A	Pesticides
A	Catastrophic hazardous material spills
A	Pollution from construction activities
A	Construction of pipelines
A	Rock quarries
A	Groundwater pumping
A	Impoundments
A	Feral hogs
A	Livestock
A	Physical modification of surface habitat for human-related activities
A	Drought
A	Flooding
D	Climate change
E	Inadequacy of existing regulatory mechanisms
E	Synergistic and additive interactions among stressors
E	Ultraviolet-B radiation

E. Analysis of Species and Proposed Critical Habitat Likely to be Affected

Many of the stressors discussed above are related to habitat modification and likewise are pertinent to proposed critical habitat effects analysis. The proposed action is likely to positively affect Georgetown salamanders and their habitat throughout their range by strengthening local regulatory mechanisms that help protect the Georgetown salamander from some of the threats of urbanization (that is, contaminants and sedimentation from stormwater runoff, changes in flow regime from impervious cover, pollution from construction activities, and physical modification of surface habitat).

III. Environmental Baseline

In a biological opinion, this section represents an analysis of the effects of past and ongoing human and natural factors leading to the current status of the species, its habitat, and ecosystem within the action area. Because the action area encompasses the entire known range of the

Georgetown salamander, we consider the environmental baseline to be essentially the status of the species, which is described in section "II: Status of Georgetown Salamander" above. The rangewide environmental baseline is also described in section 3 of the Final Environmental Assessment associated with this action.

We have issued one incidental take statement (02ETAU00-2014-F-0019) for the Georgetown salamander to the US Army Corps of Engineers for the issuance of a Clean Water Act section 404 permit for the placement of fill into jurisdictional waters during the construction of a residential housing development known as Shadow Canyon. We determined that the development of this tract could cause harm or death of up to 50 percent of the Georgetown salamanders inhabiting springs on the tract through the reduction of water quality associated with polluted run-off and potential hydrological changes.

IV. Effects of the Action

This section includes an analysis of the direct and indirect effects of the proposed action and its interrelated and interdependent activities on the species and/or proposed critical habitat.

A. Factors to be considered

The effects of the action depend on understanding how a wide variety of regulated activities affect: (1) groundwater and surface water quality and (2) the areal extent and rate of recharge and infiltration to the part of the Edwards Aquifer contributing to flow to Georgetown salamander sites. A primary factor of our uncertainty arises from not knowing the boundaries of recharge areas contributing water to any occupied Georgetown salamander site. The recharge area to karst spring systems is not necessarily obvious and cannot be strictly determined from a topographic map (Barbara Mahler, USGS, pers. comm. 2013).

Distribution of the Effects

The activities regulated by the UDC (for example, construction and development) will occur throughout the entire range of the Georgetown salamander. A significant portion of these regulated activities are in the Edwards Aquifer Recharge Zone and at elevations above sites occupied by the Georgetown salamander.

Duration and Timing of the Effects

The proposed 4(d) rule is expected to be in effect until the species is recovered and removed from the List of Endangered and Threatened Wildlife (50 CFR 17.11) or listed as endangered. Activities regulated by the UDC are expected to occur year-round for the foreseeable future.

Nature of the Effects

Due to the projected human population increase, regulated activities are expected to increase in intensity within the action area and compliance with the Act for those activities would be accomplished by following the conservation measures found in the UDC. Most regulated activities would result in some level of vegetation removal, paving of roadways, building construction, and land clearing. All of these activities may have indirect effects on all life stages

of the Georgetown salamander through habitat alteration. The action, through compliance with the UDC, will regulate the amount and distribution of these regulated activities, therefore resulting in indirect impacts to the Georgetown salamander.

B. Analyses for the Effects of the Action

Direct Effects

Direct effects are immediate effects of the project on the species or its habitat that result from the action agency. Because the 4(d) rule itself is not an on-the-ground activity that will impact the species or its habitat, no direct effects to Georgetown salamanders are expected from the action.

Interrelated and Interdependent Actions

An interrelated activity is an activity that is part of the proposed action and depends on the proposed action for its justification. An interdependent activity is an activity that has no independent utility apart from the action under consultation. Although the UDC is an activity connected to the 4(d) rule, it is an independent regulation enacted by the City of Georgetown and would exist without the 4(d) rule. There are no other actions that are interrelated or interdependent of the 4(d) rule.

Indirect Effects

Indirect effects are caused by or result from the proposed action, are later in time, and are reasonably certain to occur. The 4(d) rule will result in future activities that impact the Georgetown salamander and its habitat. The incidental take of Georgetown salamanders via regulated activities conducted consistent with the UDC is a primary factor to be considered in the effects of the action. The following is a summary of the main anticipated effects to the Georgetown salamander.

Water Quality

The UDC is expected to provide additional water quality protection above and beyond the existing local, state, and Federal regulations. Vegetated surface buffers around springs and along streams will provide additional filtering of stormwater and sheet flow (that is, an overland flow of water taking the form of a thin, continuous film) from developed sites. This will remove some additional pollutants and contaminants from stormwater that would not be removed in the absence of the UDC. It is difficult to quantify the exact removal efficiency of these vegetated buffers for all parameters of concern, but TCEQ estimates that up to 85 percent of TSS can be removed by vegetative filter strips that are at least 15.24 meters (50 feet) in diameter (Barrett 2005). In addition, regulated activities occurring within watersheds occupied by the Georgetown salamander, but at distances much farther from a spring than the 80 or 300 meter (262 or 984 feet) surface buffers around occupied springs, are likely to cause some degradation of water quality at those springs. The "true" protective buffer needed around springs to protect them from the adverse effects of impervious cover and urbanization is neither known nor is it easily identifiable. However, the Adaptive Management Working Group formed as a result of the UDC will review water quality and monitoring data on a regular basis and make recommendations for

specific changes in management direction to ensure the preservation of the Georgetown salamander.

Under chapter 11.07 of the UDC, surface buffers of 50 meters (164 feet) will be required around all springs located within the action area not known to be occupied by the Georgetown salamander. These vegetated buffers will provide additional filtering of stormwater from developed sites and prevent the direct destruction of springs unoccupied by Georgetown salamanders. Protecting unoccupied habitat may be critical for future recovery efforts for the Georgetown salamander. Any regulated activities occurring within the action area will be required to comply with the conservation measures found in the UDC. The water quality protection measures in both chapter 11.07 and Appendix A of the UDC will minimize the effects of urbanization on water quality that are discussed under Alternative A, above. Urbanization is still likely to occur due to population growth in the action area; therefore, minor adverse effects to water quality resulting from development activities that increase impervious cover may occur. However, implementation of the action may reduce the magnitude of adverse effects to water quality through the protective measures that go above and beyond what is currently required by local, state, and Federal laws. These water quality protective measures in the UDC will reduce pollutants and contaminants and increase the removal of total suspended solids throughout the watersheds in the action area, thereby alleviating the water quality impacts likely to occur as a result of development.

Water Quantity

The amount of water available to Georgetown salamander habitat is expected to decline in part due to projected increases in impervious cover over the recharge zone of the Northern Segment of the Edwards Aquifer. The stream and spring buffers described in the UDC may provide marginal benefits to water quantity by limiting the amount of impervious cover over the recharge zone within the jurisdiction of the City of Georgetown. Under the UDC, no regulated activities (for example, development) can occur within the buffers. This restriction may reduce the overall amount of impervious cover that would otherwise occur within the recharge zone, possibly resulting in more recharge to the aquifer and springflow. In addition, surface recharge features (geologic features on the ground surface that represent a significant hydrologic connection to the underlying aquifer) that exist within the designated buffers would be protected from regulated activities that could degrade or destroy these features. Protected recharge features allow surface water to replenish the underground aquifer and they are crucial for maintaining water quantity in the Edwards Aquifer.

Surface Habitat

The UDC will likely provide protections to surface Georgetown salamander habitat by establishing 80-meter (264-foot) buffers around occupied sites in which regulated activities are not allowed to occur. Salamanders in these buffers would be protected from construction activities that would otherwise disturb or destroy the rocky substrate, interstitial spaces, and aquatic invertebrates that Georgetown salamanders depend on for feeding and sheltering. However, non-regulated activities that may impact Georgetown salamander habitat, such as frequent human visitation, agriculture, oil and gas exploration, and the construction of single-family residences larger than five acres, may still occur within these buffers under the UDC.

As mentioned above, the UDC may reduce the overall amount of impervious cover that would otherwise occur within watersheds occupied by Georgetown salamanders. This could result in reduced intensity of flash flooding, which is less likely to scour substrate and remove surface habitat.

C. Georgetown Salamander Response to Proposed Action

Stressors from urbanization discussed above in the status of the species are expected to result in the degradation of habitat at most Georgetown salamander sites. If contaminants in groundwater and surface water persist at levels of significance to salamander biology, we would expect decreased growth and reproduction of salamanders. In addition, pollution would reduce the numbers and biomass of susceptible invertebrates. A significant decrease in the invertebrate prey base would adversely affect Georgetown salamander populations. We anticipate the UDC to alleviate groundwater and surface water contamination to a level that does not significantly reduce the viability of Georgetown salamander populations.

The potential decrease in recharge to the aquifer supplying flow to occupied springs may cause springs to shift from being perennial to ephemeral. In the event springflow fails, the salamander population at that spring would either die or retreat underground. Surface dwelling salamanders that retreat underground due to spring dewatering experience a temporary shrinkage in body length (Bendik and Gluesenkamp 2012). The long-term or population level consequences of catch-up growth are unknown for Georgetown salamanders. The protection of recharge features by the UDC may alleviate aquifer drawdown to a minor extent and help to maintain spring flow at sites occupied by the Georgetown salamander.

As discussed in the final listing rule, salamander populations associated with more urbanized areas appear to be at greater risk of extirpation. The action will likely alleviate that risk for all of the known Georgetown salamander populations by reducing the magnitude of threats associated with regulated activities. Regulated activities outside of designated buffer zones may continue to have adverse impacts on Georgetown salamander habitat, and by extension, Georgetown salamander populations. However, their impacts should be reduced by this action compared to their impacts in the absence of this action.

IV. Cumulative Effects

Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

The primary cumulative effects expected will result from land use changes in the action area as the city of Georgetown population grows and urbanization increases. In 2010, the human population within the City of Georgetown's extraterritorial jurisdiction was 68,821 (City of Georgetown 2013, p. 3). By one estimate, this population is expected to exceed 225,000 by 2033 (City of Georgetown 2008, p. 3.5), which would be a 227 percent increase over a 23-year period.

The Texas State Data Center (2012, pp. 166–167) estimates an increase in human population in Williamson County from 422,679 in 2010, to 2,015,294 in 2050, exceeding the human population size of adjacent Travis County where the City of Austin metropolitan area is located. This would represent a 377 percent increase over a 40-year timeframe. Surface watersheds and groundwater recharge areas contributing water to Georgetown salamander habitat are likely to be developed to some extent over the long-term (100 years) to support this human population growth, increasing detrimental effects to water quality, water quantity, and surface salamander habitat.

IV. Conclusion

This conference opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR 402.02. Instead, we have relied upon the statutory provisions of the ESA to complete the analysis with respect to proposed critical habitat. Potential alterations of critical habitat may include, but are not limited to, effects that preclude or significantly delay the development of the physical or biological features that support the life-history needs of the species for recovery. Although the proposed action allows for some degradation of Georgetown salamander habitat via development on the recharge zone of the Edwards Aquifer, there are significant protective measures in the action that will likely lessen the impacts of the development. The action also establishes an adaptive management group, which will monitor the impacts of the action on the species and modify the protective measures if necessary to protect the species. Considering these measures and the adaptive management process, we conclude that these reduced impacts will not degrade the constituent elements of proposed critical habitat in a way that would appreciably reduce the survival or recovery of the Georgetown salamander. After reviewing the current status of Georgetown salamander, the effects of the proposed action and the cumulative effects, it is the Service's conference opinion that the 4(d) rule, as proposed, is not likely to destroy of adversely modify proposed critical habitat.

To jeopardize the continued existence of a species means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species. After reviewing the current status of the Georgetown salamander, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is the Service's biological opinion that the Service's issuance of the 4(d) rule, as proposed, is not likely to jeopardize the continued existence of the Georgetown salamander.

INCIDENTAL TAKE

Section 9 of the Act and Federal regulations pursuant to Section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly

impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of Section 7(b)(4) and Section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by the Service so that they become binding conditions of any grant or permit issued to the Applicants, as appropriate, for the exemption in Section 7(o)(2) to apply. The Service has a continuing duty to regulate the activity covered by this Incidental Take Statement. If the Service: 1) fails to assume and implement the terms and conditions or 2) fails to require the Applicants to adhere to the terms and conditions of the Incidental Take Statement through enforceable terms that are added to the Permit or grant document, the protective coverage of Section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the Service or Applicants must report the progress of the action and its impact on the species to the Service as specified in the Incidental Take Statement [50 CFR §402.14(i)(3)].

Amount or Extent of Take Anticipated

Georgetown salamander populations are difficult to quantify due to their cryptic appearance, their subterranean habits, and the lack of private land access. Although we know changes to water quality will impact all Georgetown salamanders in a population, the best available scientific information has determined population sizes for only 2 of the 18 Georgetown salamander sites. Therefore, it is impractical to quantify the amount of incidental take across the entire range of the species by the number of individual salamanders. However, the level of take of Georgetown salamanders can be anticipated by examining the water quality of occupied Georgetown salamander sites and using this as a surrogate. Quantifying changes in the water quality of Georgetown salamander habitat is a practical and meaningful alternative to quantifying and monitoring the anticipated incidental take in terms of individual salamanders caused by the action. It is a practical alternative because effects to water quality are causally related to the take of all Georgetown salamanders at a given site (not just the surface individuals that can be accurately surveyed), these effects can be readily monitored, and the extent of impacts to water quality provides a clear standard for when the anticipated extent of take has been exceeded.

Specific water conductance, dissolved oxygen, and nitrate concentrations are water quality measurements commonly used to determine how much a spring has been impacted by development. We anticipate that development within the range of the Georgetown salamander will result in a decrease in dissolved oxygen and increases in specific water conductance and nitrate at occupied sites. Precisely how much these parameters will change will depend on factors that are currently unknown, such as site-specific water chemistry, the amount and type of development in the recharge zone, and future water quantity fluctuations. However, we predict

that the water quality protection measures in the proposed action will prevent dissolved oxygen from falling below 5 mg/L, specific water conductance from rising above 800 µS/cm, and nitrate from rising above 3 mg/L. These are thresholds at which declines in closely related *Eurycea* salamander abundance have been detected (Bowles *et al.* 2006; Turner 2009).

We anticipate that incidental take of Georgetown salamanders in the form of harm will occur across the species' range due to increased urban development in the recharge zone of the Northern Edwards Aquifer. We anticipate that water quality in Georgetown salamander habitat will decline over time, resulting in negative impacts to individual salamander growth and reproduction. However, we do not expect these individual-level impacts to cause significant declines in Georgetown salamander populations. If monitoring finds that the water quality threshold levels described above have been exceeded by monthly averages for three or more consecutive months at any occupied site, then take of Georgetown salamanders has been exceeded and reinitiation of this consultation would be warranted.

Reasonable and Prudent Measures

We believe the following reasonable and prudent measures are necessary and appropriate to minimize the impacts of incidental take of Georgetown salamanders.

1. At least three representative Georgetown salamander sites are monitored regularly for potential changes in water quality (specifically, specific water conductance, dissolved oxygen, and nitrate) to determine if take has been exceeded.
2. We will ensure that the City of Georgetown is implementing the UDC regulations in compliance with all conservation measures therein and that the implementation is consistent with the conservation of the Georgetown salamander.
3. We will ensure that the Adaptive Management Working Group reviews projects that comply with Appendix A and appropriately responds to new scientific information that calls for modifications to the UDC and/or Appendix A. These modifications must provide equal or greater conservation benefits to the Georgetown salamander.

<u>Terms and Conditions</u>

To be exempt from the prohibitions of Section 9 of the ESA, the Service must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline reporting and monitoring requirements. These terms and conditions are non-discretionary.

1) We will review data and meeting notes submitted by the City of Georgetown and the Adaptive Management Working Group regarding the amount and general location of projects approved under the regulations and guidance associated with the 4(d) rule.
2) If we receive evidence that take of Georgetown salamanders under this 4(d) special rule is having an effect that is inconsistent with the conservation of the species, we may immediately prohibit or restrict such take as appropriate for the conservation of the species.

The Service believes that the proposed action will harm Georgetown salamanders by reducing water quality (as measured by dissolved oxygen, nitrate, and specific water conductance) no less than a threshold that negatively impacts Georgetown salamander populations. The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. If, during the course of the action, this level of incidental take is exceeded, such incidental take represents new information requiring reinitiation of consultation and review of the reasonable and prudent measures provided. We would immediately provide an explanation of the causes of the taking and review the need for possible modification of our reasonable and prudent measures.

REPORTING REQUIREMENTS

Records on permitted take will be maintained by the City of Georgetown and the Adaptive Management Working Group, and made available to the Service upon request.

REINITIATION STATEMENT

This concludes formal consultation on our proposed 4(d) rule for the Georgetown salamander. As provided in 50 CFR §402.16, re-initiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: 1) the amount or extent of incidental take is exceeded; 2) new information reveals effects of the agency action that may impact listed species or critical habitat in a manner or to an extent not considered in this opinion, 3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion, or 4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending re-initiation.

If you have any questions regarding this opinion, please contact Adam Zerrenner, Field Supervisor, at 512-490-0057, ext. 248.

Sincerely,

Adam Zerrenner
Austin Field Supervisor